Astrophysics Research And Analysis

Extreme Energy Particle Astrophysics with ANITA-V

Completed Technology Project (2017 - 2021)

Project Introduction

This is the lead proposal for the Antarctic Impulsive Transient Antenna (ANITA) mission. ANITA seeks to detect and elucidate the sources of the highest energy particles in the universe via measurements of cosmogenic ultra-high energy neutrinos at energies above 1EeV (1EeV=10^18 eV). Such neutrinos are in many cases predicted to be the only unattenuated astrophysical messengers that arrive at Earth with precise directional information, since neutrinos are neutral particles with very weak interactions with matter in intergalactic space. Neutrinos that ANITA seeks to detect will signal the presence of the most extreme astrophysical accelerators and environments, and complement the information available via electromagnetic messengers from gamma-rays to radio waves. ANITA uses a long-duration balloon payload equipped with 48 dual-polarization horn antennas to detect radio impulses in the frequency range 200-1200 MHz, within which the properties of cold Antarctic ice include extreme radio-transparency and depths of up to 4 km. If a neutrino interacts anywhere within the ice sheet in ANITA's view from stratospheric altitudes, we can detect the emerging radio impulse and determine its direction and other characteristics with high precision. This in turn allows us to select candidate neutrinos from among the thermal and anthropogenic backgrounds with high confidence, and to derive angular information about the arrival direction of such candidates as well. Recently ANITA analysis investigated a new detection channel, which focuses on tau-lepton-generating neutrinos, which lead to a unique experimental signature for which ANITA has potentially very high sensitivity, and a candidate event has been detected in prior data. This new detection channel has added to the variety of methods by which ANITA continues to improve its sensitivity and reach into predicted models for cosmogenic neutrinos, for which ANITA has among the best constraints of any detector to date. ANITA is currently the only active NASA mission with the capability to measure ultra-high energy neutrinos, and ANITA's ultra-high energy neutrino sensitivity while in flight is unmatched by any other instrument, ground- or space-based. As such it is a direct contributor to our understanding of the origin and evolution of the universe, through astrophysical messengers that provide unique information about the most extreme and energetic objects in the cosmos.

Anticipated Benefits

The Astrophysics Research and Analysis program (APRA) supports suborbital and suborbital-class investigations, development of detectors and supporting technology, laboratory astrophysics, and limited ground based observing. Basic research proposals in these areas are solicited for investigations that are relevant to NASA's programs in astronomy and astrophysics, including the entire range of photons, gravitational waves, and particle astrophysics. The emphasis of this solicitation is on technologies and investigations that advance NASA astrophysics missions and goals.

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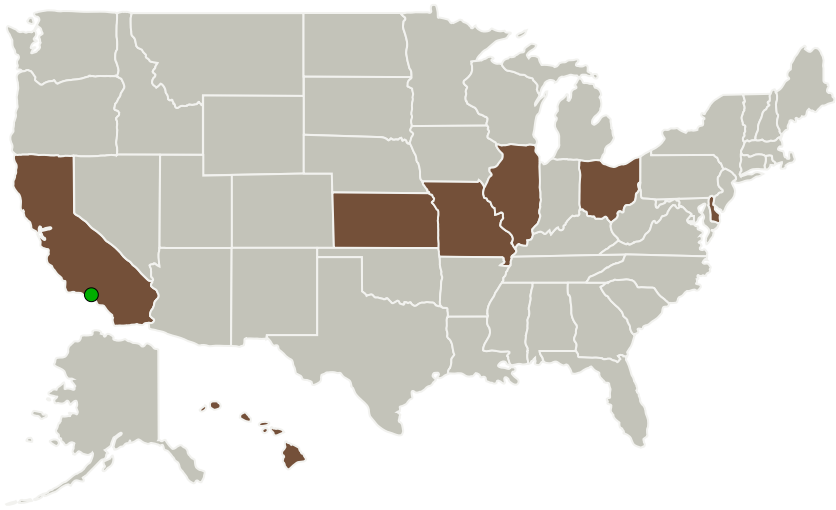
Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Organization:

University of Hawaii Maui College

Responsible Program:

Astrophysics Research and Analysis

Project Management

Program Director:

Michael A Garcia

Program Manager:

Dominic J Benford

Principal Investigator:

Peter W Gorham

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Organizations Performing Work	Role	Type	Location
University of Hawaii Maui College	Lead Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH), Asian American Native American Pacific Islander (AANAPISI)	Kahului, Hawaii
California Polytechnic State University-San Luis Obispo(Cal Poly)	Supporting Organization	Academia Asian American Native American Pacific Islander (AANAPISI)	San Luis Obispo, California
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
Kavli Institute for Cosmological Physics(KICP)	Supporting Organization	Academia	Chicago, Illinois
National Taiwan University	Supporting Organization	Academia	Taipei, Outside the United States, Taiwan, Province of China
Ohio State University-Main Campus	Supporting Organization	Academia	Columbus, Ohio

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Project Management *(cont.)*

Co-Investigators:

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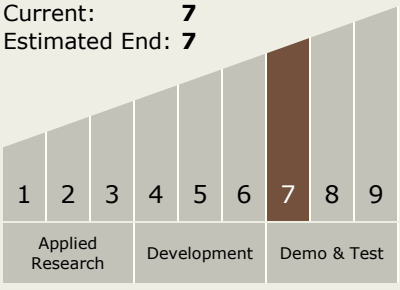
James J Beatty
Patrick S Allison
Viatcheslav Bugaev

Technology Maturity (TRL)

Start: **7**
Current: **7**
Estimated End: **7**



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Organizations Performing Work	Role	Type	Location
Stanford University(Stanford)	Supporting Organization	Academia	Stanford, California
University College London	Supporting Organization	Academia	Dorking, United Kingdom
University of Delaware	Supporting Organization	Academia	Newark, Delaware
University of Hawaii at Manoa	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH), Asian American Native American Pacific Islander (AANAPISI)	Honolulu, Hawaii
University of Kansas	Supporting Organization	Academia	Lawrence, Kansas
University of Southern California(USC)	Supporting Organization	Academia	Los Angeles, California
Washington University in St Louis	Supporting Organization	Academia	Saint Louis, Missouri

Primary U.S. Work Locations	
California	Delaware

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Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.2 Energy Storage
    - TX03.2.1 Electrochemical: Batteries

Target Destination

Outside the Solar System

Primary U.S. Work Locations *(cont.)*	
Hawaii	Illinois
Kansas	Missouri
Ohio	